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CONTRIBUTIONS  
FROM THE  
CUSHMAN LABORATORY  
FOR  
FORAMINIFERAL RESEARCH

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# CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

Brook Road, Sharon, Mass., U. S. A.

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CONTRIBUTIONS FROM THE CUSHMAN  
LABORATORY FOR FORAMINIFERAL RESEARCH240. THE GENUS *CANCERIS* AND ITS SPECIES\*

By JOSEPH A. CUSHMAN and RUTH TODD

There has been a great deal of confusion in regard to the characters of the various species assigned to the genus *Canceris*. This is probably partly due to the fact that the early species were described in works that are not accessible to many workers, and also to the fact that many of the early figures are not always accurate in their details. In this paper we have attempted to set forth the results of a study of the topotypes of the earlier described species. The original figures of d'Orbigny, prepared for his 1826 work, were only in part published, and it was not until Fornasini published outline drawings of these, after a lapse of nearly three-quarters of a century, that it was possible to interpret many of these earlier species.

We have been fortunate in having topotype material from the localities from which d'Orbigny's species were described. From these we have tried to set forth the characters as we have been able to make them out. During this study we have noted several species and varieties which seem to have been hitherto undescribed. These are figured and described in the following pages.

Genus *CANCERIS* Montfort, 1808Genotype, *Nautilus auriculus*, var.  $\beta$  Fichtel and Moll.

*Canceris* MONTFORT, Conch. Syst., vol. 1, 1808, p. 267.—CUSHMAN, Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 279.

*Nautilus* (part) FICHTEL and MOLL, 1798 (not LINNAEUS).

*Rotalina* (part) WILLIAMSON, 1858 (not D'ORBIGNY).

*Pulvinulina* (part) of authors.

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Test trochoid, dorsal side evolute, ventral side involute, nearly equally biconvex, compressed; chambers few, rapidly enlarging, the last-formed one projecting inward forming a lobe over the umbilicus; wall calcareous, perforate, umbilical area with a clear plate of rather large dimensions for the size of the test; aperture narrow, on the inner border of the ventral side of the last-formed chamber.

From the original figure given by Montfort it would be difficult to determine the characters of this genus. He refers, however, to the figures given by Fichtel and Moll and this definitely fixes the characters. Montfort's plate and description are reproduced (Plate 17).

*Canceris* is most closely allied to *Baggina* Cushman, 1926, but the latter is decidedly involute on the dorsal side and there is typically no projecting lip above the umbilical area. The clear area on the ventral side is present in both genera and the two are evidently very closely related.

From the available material and the records, species of the genus occur at medium depths with a wide geographic range in temperate and tropical regions. From available data the geologic range is from Eocene to Recent. The various species show considerable variation and probably for this reason the synonymy of the earlier named species is difficult to disentangle. In the case of records without figures where no material is available, we have been unable to definitely place them. Also some of the published figures are difficult to place without seeing the original specimens. It has seemed to us better to leave out these records than to add to the confusion that is present in the group.

The various species are presented in approximately chronologic order as they appeared in the literature, but new varieties are given under some of the earlier named species.

In order to facilitate the use of the data given here for purposes of correlation, the accompanying list shows the geologic ranges of the various species.

<i>C. mauryae</i> Cushman and Renz	Midway Eocene	Trinidad
<i>C. claibornensis</i> Howe	Claiborne Eocene	Southeastern U. S.
<i>C. danvillensis</i> Howe and Wallace	Jackson Eocene	Southeastern U. S.
<i>C. sp.</i>	Jackson Eocene	Southeastern U. S.

<i>C. cubensis</i> Cushman and Bermudez	Eocene and upper Oligocene	Cuba
<i>C. pauciloculatus</i> Cushman and McGlamery	Oligocene	Southeastern U. S.
<i>C. mexicanus</i> , n. sp.	Oligocene	Mexico
<i>C. turgidus</i> , n. sp.	Oligocene	Germany
<i>C. auriculus</i> , var. <i>primitivus</i> , n. var.	Oligocene	Germany
<i>C. intermedius</i> , n. sp.	Oligocene and Miocene	Australia
<i>C. ovatus</i> , n. sp.	Oligocene and Miocene	Australia
<i>C. tumidus</i> , n. sp.	Miocene	Egypt
<i>C. sp.</i>	Miocene	California
<i>C. baggi</i> Cushman and Kleinpell	Miocene	California
<i>C. baggi</i> , var. <i>planus</i> , n. var.	Miocene and Recent	Florida and California
<i>C. sagra</i> , var. <i>communis</i> , n. var.	Miocene and Recent	Florida and California
<i>C. auriculus</i> (Fichtel and Moll)	Miocene to Recent	Central Europe, Indo-Pacific
<i>C. oblongus</i> (Williamson)	Pliocene ? to Recent	Western Europe, Atlantic
<i>C. peroblongus</i> (Cushman)	Recent	Indo-Pacific
<i>C. carinatus</i> (Millett)	Recent	Indo-Pacific
<i>C. torquertus</i> , n. sp.	Recent	Indo-Pacific
<i>C. indicus</i> (Cushman)	Recent	Indo-Pacific
<i>C. sagra</i> (d'Orbigny)	Recent	West Indies, Atlantic

There seem to be two divisions of the species of *Cancris*. In one, the typical form, the test is decidedly compressed at the periphery and often distinctly keeled. In the other, represented by *C. indicus* and allied species, the periphery is normally broadly rounded.

The earlier species of the genus have only four or five chambers in the adult whorl and the final chamber is about as broad as high. As evolution took place, the number of chambers in the adult whorl has increased, and lower, broader chambers have developed in most species.

**CANCERIS AURICULUS** (Fichtel and Moll) (Pl. 18, figs. 1-11; Pl. 23, fig. 6)

*Nautilus auricula* FICHTEL and MOLL, Test. Micr., 1803, var.  $\alpha$ , p. 108, pl. 20, figs. a-c; var.  $\beta$ , p. 110, pl. 20, figs. d-f.

*Pulvinulina auricula* CUSHMAN, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 329, pl. 69, fig. 3.

*Cancris auriculus* LEROY, Colorado School Mines Quart., vol. 36, No. 1, pt. 3, 1941, p. 117, pl. 3, figs. 7-9; 16-18.



*Hammonia tuberculata* SOLDANI, Testac. I, 1789, p. 57, pl. 38, fig. H?

*Rotalia brongniartii* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 273, No. 27.—FORNASINI, Mem. Accad. Sci. Bol., ser. 5a, vol. 7, 1898, p. 248, fig. 1.

*Rotalina brongniartii* D'ORBIGNY, Foram. Fossiles Vienne, 1846, p. 158, pl. 8, figs. 22-24.

*Rotalia elliptica* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 273, No. 28.—FORNASINI, Mem. Accad. Sci. Bol., ser. 6, vol. 3, 1906, p. 66, pl. 3, fig. 3.

Test slightly longer than broad, more strongly convex on the ventral side than the dorsal, increasing in convexity to the last-formed chamber, periphery acute with a distinct keel of clear shell material; chambers uniform in shape but increasing rapidly in size as added, 6 or 7 in the adult whorl, evenly arcuate on the dorsal side with the greatest height about the middle of the chamber, inflated on the ventral side with a lobe at the inner end of the last-formed chamber projecting inward and backward over the umbilicus, the lobes of previous chambers often appearing as small rounded bosses surrounding the umbilicus, overlapping so that the last-formed chamber comprises about half the ventral surface of the test; sutures strongly and evenly curved, limbate on the dorsal side, depressed on the ventral side; wall smooth, rather coarsely perforate except for an oval clear area about half the height of the chamber on the ventral side at the base of the last-formed chamber; aperture a low, elongate opening on the ventral side under the lobe of the last-formed chamber. Length 0.65-0.80 mm.; breadth 0.45-0.55 mm.; thickness 0.25-0.30 mm.

The original Latin description of Fichtel and Moll follows:

"Testa spiralis subinvoluta, ovalis, laevis, utrinque satis convexa, exumbilicata; dorso acute carinato; articulis septem conspicuis subelevatis, antrorsum leviter convexis, ex centro radiantibus, exceptis duobus ultimis extravagantibus s. extra centrum initium capientibus, ultimi angulo initiali seu interno, apice subobtusos, parte autem opposita externa valde lata &

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#### EXPLANATION OF PLATE 17

Reproduction of pages 266 and 267 of Montfort, "Conchyliologie Systématique, et Classification Méthodique des Coquilles," vol. 1, 1808, showing the original figure and description of the genus *Cancris*.

## LE CANCRIDE.

*Caractères génériques.* Coquille adhérente, univalve, cloisonnée; recourbée au sommet, mais droite en s'avancant vers la base; bouche lancéolée, recouverte par un diaphragme bombé, et divisé dans sa longueur par une raie ou fente; têt arrondi, dos caréné vers la base; cloisons unies; siphon inconnu.

*Espèce servant de type au genre.*

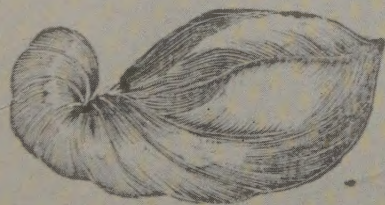
*Le Cancride ord. Cancris auriculatus.*

*Nautilus auriculus.* Der chiffermige schiffer. Testac. microsc. a Leo. von Fichtel, etc., pag. 110. tab. 20. fig. d, e, f.

Ce genre s'écarte du précédent, malgré toute l'analogie qu'il pourroit avoir avec lui, parce qu'au lieu d'un siphon angulaire et étoilé, sa bouche présente au contraire une longue fente ou raie qui, probablement, renferme ce siphon; sa base se termine en pointe, et le dos rond jusqu'à elle se carène en formant une espèce de bec avancé; du reste la coquille servant de type est assez ventrue et comme soufflée.

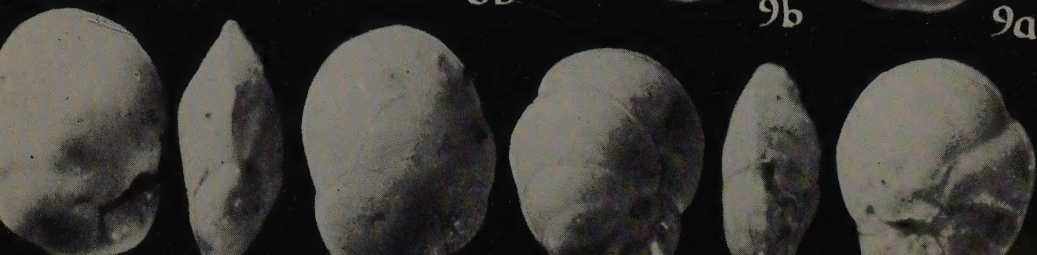
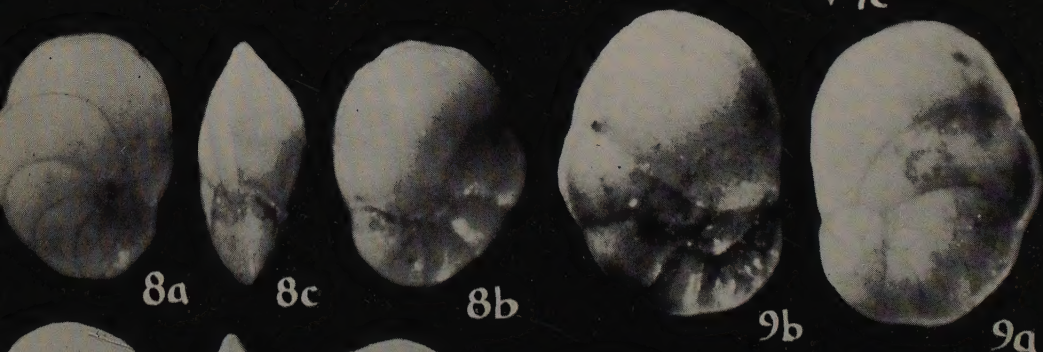
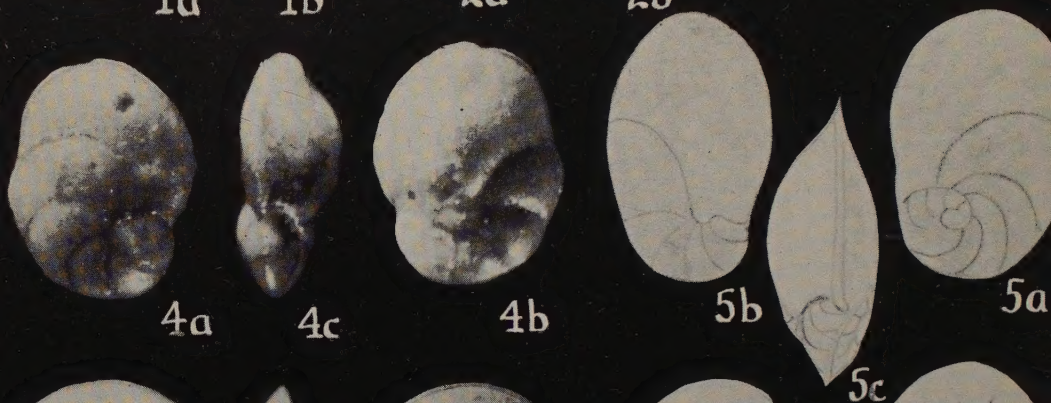
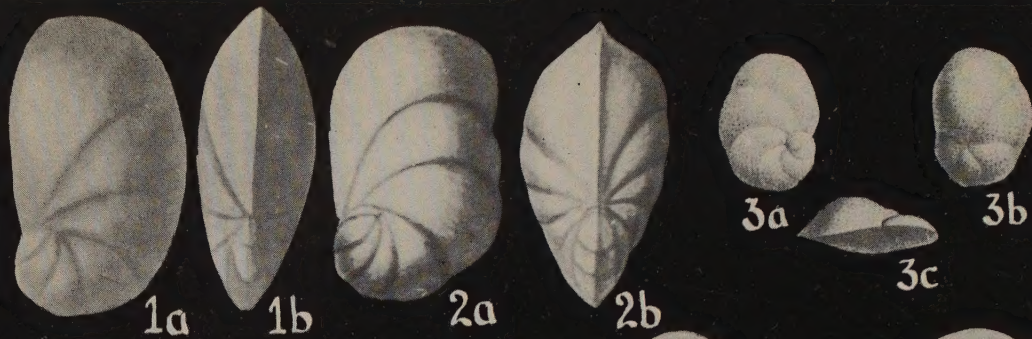
Extrêmement transparente par sa pellucidité, elle laisse lire au travers de son têt la disposition de ses cloisons; et on la trouve sur les algues, les fucus et les crustacés de la Méditerranée, sur lesquels cependant elle est assez rare, quoiqu'elle paroisse préférer les limacologistes pour se placer sur leur *cruste* ou têt.

## LXVII. GENRE.



CANCRIDE; en latin, Cancris.







rotundata; de *dissepimentis* simile huc quadrans valet. *Planum orale* hic locum non habet, quia carina dorsi ad dictum anguli apicem usque producitur. Nec *orificium* distinguibile, an rimula parva linearis transversalis per angulum externum ultimi maximi articuli?

"COLOR fuscescens, a terra ferruginea, qua haec testula farcta & tincta est.

"PATRIA Coroncina in agro Senensi Hetururiae, fossilis.

"MENSURA  $\frac{2}{5}$  lin. long."

As noted in the original description and shown on the hand-colored plate, the color is reddish in the fossil forms (var.  $\alpha$ ) while the Recent ones from the Mediterranean (var.  $\beta$ ) are described as whitish and pellucid.

"*Rotalia brongniartii*" was named on the basis of material from Castel Arquato, Italy, but without figures until Fornasini published d'Orbigny's figures in 1898. In 1846 d'Orbigny recorded, with figures, his species from the Miocene of Nussdorf in the Vienna Basin. "*Rotalia elliptica*" was named on the basis of material from Dax, France, but likewise without figures until Fornasini published d'Orbigny's figures in 1906. We have compared topotypes of both "*R. brongniartii*" and "*R. elliptica*" with topotypes of *C. auriculus* and have found no essential differences between the three species.

We have specimens referable to *C. auriculus* from the following Miocene localities: Nussdorf, Vöslau, and Niederleis, in Austria; Kostež, Banat, Hungary; Dingden, Germany; in France,

#### EXPLANATION OF PLATE 18

All figures approximately  $\times 50$

Unless otherwise noted: *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIG. 1. "*Nautilus auricula*, var.  $\alpha$ " Fichtel and Moll. Pliocene, Coroncina, Italy. *a*, side view; *b*, peripheral view. (After Fichtel and Moll). 2. "*Nautilus auricula*, var.  $\beta$ " Fichtel and Moll. Recent, Mediterranean Sea. *a*, side view; *b*, peripheral view. (After Fichtel and Moll). 3. "*Rotalina brongniartii* d'Orbigny." Miocene, Vienna Basin. (After d'Orbigny). 4, 6, 8-11. *Cancris auriculus* (Fichtel and Moll). 4, Topotype. Pliocene, Coroncina, Italy. 6, 9, Topotypes of "*Rotalia brongniartii* d'Orbigny." Pliocene, Castel Arquato, Italy. 8, Miocene, Nussdorf, Vienna Basin. 10, Miocene, Dingden, Germany. 11, Miocene, Oran, Africa. 5. "*Rotalia brongniartii* d'Orbigny." Pliocene, Castel Arquato. (After Fornasini). 6. "*Rotalia elliptica* d'Orbigny." Miocene, Dax, France. (After Fornasini).

La Brède, Bordelais; Pont Gourguet, Bordelais, Saucats; Le Coquillat, Leognan; Moulin de Minoy, Salles; Mont de Marson, St. Avit near Dax; and Marniere de Cabannes, St. Paul, Dax; in Egypt, Gebel Murr, Wadi el Bir, and Shallûfa; and Oran, Algeria. In the Pliocene *C. auriculus* occurs at Coroncina, Castel Arquato, and Monte Mario, Italy, and we have specimens from Dr. LeRoy from the upper Pliocene of West Java, N. E. I. As a living form it occurs in the Mediterranean Sea and in the East Indian region. We have specimens from the Bay of Naples, from several stations in the Philippine Islands, and from off Singapore.

**CANCERIS AURICULUS** (Fichtel and Moll), var. **PRIMITIVUS** Cushman and Todd, n. var.

(Pl. 19, figs. 1, 2)

Variety differing from the typical in having a smaller, narrower test with more depressed sutures, and in being more umbilicate and more convex on the ventral side. Length 0.40-0.53 mm.; breadth 0.30-0.40 mm.; thickness 0.15-0.22 mm.

Holotype of variety (Cushman Coll. No. 38761) from the Oligocene of Osnabrück, Germany.

We have material also from the Oligocene of Doberg, near Bünde, and from Ahnatal, Cassel, Germany.

This is evidently the ancestral form of *C. auriculus* (Fichtel and Moll) which became widely distributed in the Miocene and later in Central and Southern Europe and Northern Africa.

**CANCERIS SAGRA** (d'Orbigny) (Pl. 19, figs. 3-7)

*Rotalina sagra* D'ORBIGNY, in DE LA SAGRA, Hist. Physiq. etc. Cuba, 1839, "Foraminifères," p. 77, pl. 5, figs. 13-15.

*Canceris sagra* CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 8, 1931, p. 74, pl. 15, fig. 2.—CUSHMAN and PARKER, Proc. U. S. Nat. Mus., vol. 80, Art. 3, 1931, p. 20.—BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 9, 1935, p. 212.

*Pulvinulina oblonga* H. B. BRADY, PARKER, and JONES (not WILLIAMSON), Trans. Zool. Soc. London, vol. 12, 1888, p. 229, pl. 46, fig. 5.—PEARCEY, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 1041.



*Pulvinulina semipunctata* CUSHMAN, Publ. No. 311, Carnegie Inst. Washington, 1922, p. 51, pl. 8, figs. 5, 6; Publ. No. 344, Carnegie Inst. Washington, 1926, p. 78.

Test small, slightly longer than broad, flattened on the dorsal side, moderately convex on the ventral side, periphery lobulated, acute, with a narrow, distinct keel of clear shell material; chambers uniform in shape but increasing rapidly in size as added, usually 6, rarely 7, chambers in the adult whorl, arcuate on the dorsal side with the greatest height toward the distal end, tapering toward the proximal end, inflated on the ventral side with a lobe at the inner end of the last-formed chamber projecting inward over the umbilicus, overlapping so that the last-formed chamber comprises usually more than half the ventral surface of the test; sutures distinct, very strongly curved on the dorsal side, especially toward the periphery of the test, depressed on the ventral side; wall smooth, finely perforate, except for an oval clear area  $\frac{1}{3}$  to  $\frac{1}{2}$  the height of the last-formed chamber; aperture a low, elongate opening on the ventral side under the lobe of the last-formed chamber. Length 0.45-0.60 mm.; breadth 0.30-0.35 mm.; thickness 0.16-0.22 mm.

D'Orbigny's original Latin description follows:

"*Rotalina. Testa elliptico-oblonga, depressa, punctata, alba, carinata, supra et subtus inaequaliter convexa; spira subcomplanata, anfractibus duobus, simplicibus; loculis sex angulatis, carinatis, rapidissime crescentibus.*

"*Dimensions. Diametre . . . .  $\frac{1}{4}$  de millim.*"

The species was described from the sands of Cuba and Jamaica and recorded as very rare. We believe d'Orbigny's species may have been described on the basis of immature forms, because of the extremely small size and lack of a lobulated periphery. His type figure would fit in size and form our figured specimens from various localities in the West Indies and South Atlantic if the last two or three chambers were left off.

Specimens seem to vary considerably, especially in outline of the test, but the species seems a distinct one in its small size, comparatively flat form, and peculiarly curved sutures. So far as our collections show, *C. sagra* occurs in its typical form only in Recent material in the general West Indian and adjacent Atlantic region.

*CANCERIS SAGRA* (d'Orbigny), var. *COMMUNIS* Cushman and Todd, n. var.

(Pl. 19, figs. 8-11; Pl. 20, fig. 1)

*Pulvinulina sagra* CUSHMAN (not D'ORBIGNY), Bull. 676, U. S. Geol. Survey, 1918, p. 65, pl. 22, fig. 3; pl. 23, fig. 1; Bull. 103, U. S. Nat. Mus., 1918, p. 70, pl. 24, fig. 6.

*Canceris sagra* CUSHMAN (not D'ORBIGNY), Bull. 4, Florida Geol. Survey 1930, p. 56, pl. 11, fig. 4.—CUSHMAN and PONTON, Bull. 9, Florida Geol. Survey, 1932, p. 94, pl. 14, fig. 3.—ELLISOR, Bull. Amer. Assoc. Petr. Geol., vol. 24, No. 3, 1940, pl. 6, fig. 6.

*Canceris auricula* CUSHMAN (not FICHTEL and MOLL), Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, No. 10, 1927, p. 164, pl. 5, fig. 10.—CUSHMAN and VALENTINE, Contr. Dept. Geol. Stanford Univ., vol. 1, No. 1, 1930, p. 25, pl. 8, fig. 1.

Variety differing from the typical in the larger size and greater number of chambers in the adult whorl, as many as 7 or 8. Length 0.65-0.85 mm.; breadth 0.40-0.50 mm.; thickness 0.25-0.30 mm.

Holotype of variety (Cushman Coll. No. 38767) from the middle Miocene, Shoal River formation, *Cardium* zone,  $\frac{1}{4}$  mi. W. of Alaquia School or Pleasant Ridge Church in sec. 6, T. 2 N., R. 19 W., Walton Co., Fla. (U. S. G. S. Loc. 9959.)

The variety is fairly common in the Miocene of Florida and is believed to be the ancestral form from which *C. sagra* descended through reduction in size and number of chambers. This evolutionary trend is evident even in the series of specimens we have from Florida from the lower part of the middle Miocene (Shoal

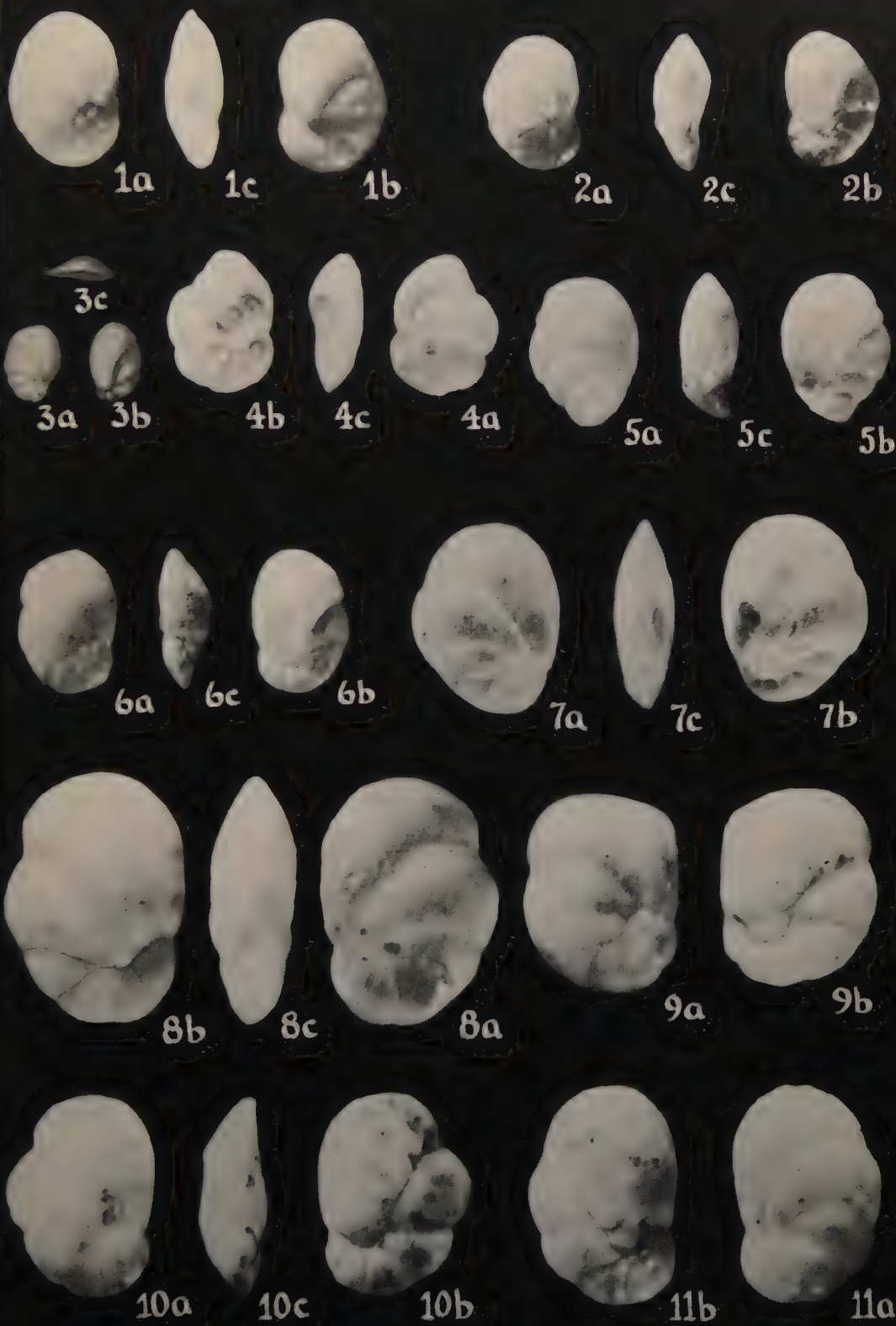
#### EXPLANATION OF PLATE 19

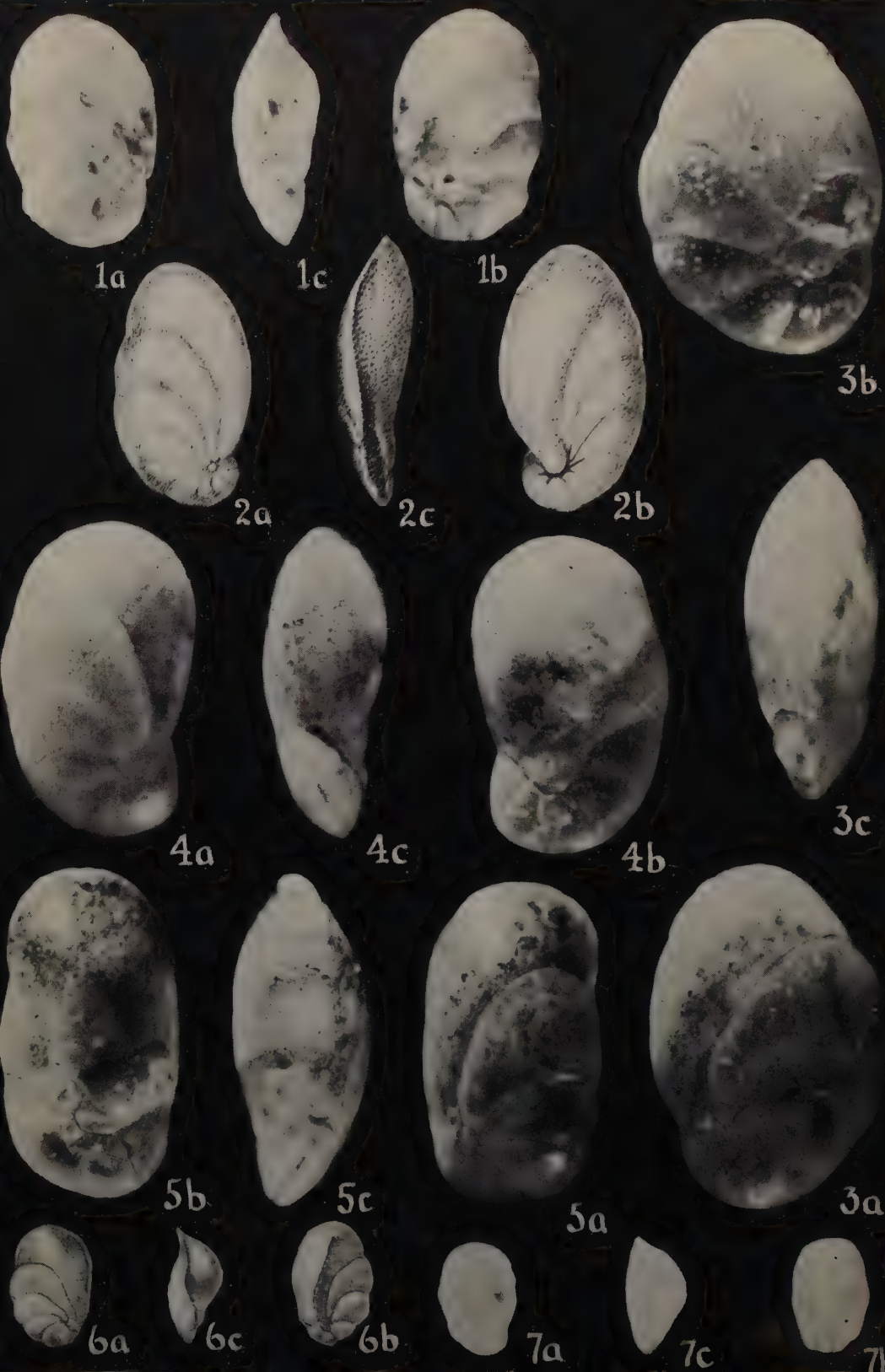
All figures approximately  $\times 50$

a, dorsal view; b, ventral view; c, peripheral view.

FIGS. 1, 2. *Canceris auriculus* (Fichtel and Moll), var. *primitivus* Cushman and Todd, n. var. 1, Holotype. Oligocene, Osnabrück, Germany. 2, Ahnatal, Cassel, Germany. 3-7. *C. sagra* (d'Orbigny). 3, Recent, West Indies. (After d'Orbigny). 4, Largo Shoal, San Juan Harbor, Porto Rico. 7 feet. 5, Rivadavia, Brazil. 6, Rio de Janeiro Harbor, Brazil. 7, *Chalenger* Sta. 24, off Culebra Island, north of St. Thomas, West Indies. 390 fathoms. 8-11. *C. sagra* (d'Orbigny), var. *communis* Cushman and Todd, n. var. 8, Holotype. Miocene, Shoal River formation, *Cardium* zone,  $\frac{1}{4}$  mi. W. of Alaquia School or Pleasant Ridge Church, Walton Co., Fla. 9, Miocene, Choctawhatchee formation, *Ecphora* zone, Dripping Springs on Fourmile Creek,  $\frac{3}{4}$  mi. NW. of Clarksville, Calhoun Co., Fla. 10, Miocene, Shoal River formation, Shell Bluff, Shoal River, 5 mi. N. of Mossyhead, Walton Co., Fla. 11, Miocene, Choctawhatchee formation, *Arca* zone, Bells Farm, SW.  $\frac{1}{4}$  of NE.  $\frac{1}{4}$  sec. 29, T. 2 N., R. 19 W., Walton Co., Fla.









River formation) through the upper part of the upper Miocene (*Cancellaria* zone of the Choctawhatchee formation).

A few Recent specimens from off California may be referred to this variety.

**CANCERIS OBLONGUS (Williamson) (Pl. 20, figs. 2-5)**

*Rotalina oblonga* WILLIAMSON, Recent British Forams., 1858, p. 51, pl. 4, figs. 98-100.

*Pulvinulina auricula* GOËS (not FICHTEL and MOLL), Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 98, pl. 16, fig. 809 (not fig. 810).—FLINT, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 329, pl. 73, fig. 2.

*Canceris auricula* CUSHMAN (not FICHTEL and MOLL), Bull. 104, U. S. Nat. Mus., pt. 8, 1931, p. 72, pl. 15, fig. 1.

Test large for the genus, about  $1\frac{1}{2}$  times as long as broad, about equally biconvex, periphery subacute with a very slight keel of clear shell material usually unnoticeable from the ventral side; chambers uniform in shape but increasing rapidly in size as added, 7 or 8 in the adult whorl, arcuate on the dorsal side with the greatest height near the distal end and tapering toward the proximal end, slightly inflated on the ventral side with a lobe at the inner end of the last-formed chamber projecting inward over the umbilicus, the earlier chambers showing small bosses at their inner ends, overlapping so that the last-formed chamber comprises about half the ventral surface of the test; sutures on the dorsal side limbate and strongly curved, depressed and nearly radial on the ventral side; wall smooth, finely perforate except for a small oval clear area on the ventral side at the base of the last-formed chamber; aperture a low elongate opening on the ventral side under the lobe of the last-formed chamber. Length about 1.00 mm.; breadth 0.55-0.65 mm.; thickness 0.40 mm.

**EXPLANATION OF PLATE 20**

All figures approximately  $\times 50$

*a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIG. 1. *Canceris sagra* (d'Orbigny), var. *communis* Cushman and Todd, n. var. Recent, off Santa Catalina, California. 2-5. *C. oblongus* (Williamson). 2, Recent, British Isles. (After Williamson). 3, 4, Log 28, "Lord Bandon," off Baltimore, SW. Ireland. 26 fathoms. 5, Off Ragged Key, Florida. 75 fathoms. 6, 7. *C. carinatus* (Millett). 6, Recent, Malay Archipelago. (After Millett). 7, *Albatross* D 5206, off western Samar, Philippines. 32 fathoms.

As there are several discrepancies between Williamson's type figures and his description, and, as the description is more compatible with our specimens from a number of localities off south-west Ireland, the original description is given for reference:

"Shell inequilateral, consisting of rather less than two complete convolutions, both of which are visible superiorly; the outermost consisting of about eight somewhat arcuate segments, which increase rapidly in length as they approach the ultimate one. Superior lateral surface smooth and almost flat. Segments but slightly ventricose, and with little or no umbilical depression. Inferior lateral surface with the segments more ventricose, especially the ultimate one, from the inferior umbilical border of which a small flat lamina projects, covering the inferior umbilicus, but usually leaving a narrow space beneath the two portions. Septal lines, which diverge from the umbilicus, deeply and abruptly excavated at their umbilical extremities, causing the angular inferior umbilical margins to be prominent and well defined. Septal plane forming part of the convex inferior surface of the segment. Septal orifice narrow, crescentic, situate close to the preceding convolution, between its periphery and the projecting umbilical lamina of the segments. Peripheral border slightly lobulate, somewhat angular or even carinated, especially at the anterior border of the ultimate segment. Texture semi-hyaline, beautifully foraminated. Hue pale olive. Diam.  $1/30$ ."

Williamson recorded his species at eleven localities in the British Isles, giving Skye as the "chief locality." In addition to the British Isles, the species occurs rarely at a number of localities in the western Atlantic, usually being smaller and less well developed.

In the Pliocene, Crag noir, from near Antwerp, Belgium, there occur specimens intermediate in characters between *C. oblongus* and *C. auriculus*. They seem closer to *C. oblongus* in size and shape of chambers, differing mainly in being proportionately broader, and in having one less chamber in the adult whorl.

CANCERIS CARINATUS (Millett) (Pl. 20, figs. 6, 7)

*Pulvinulina oblonga* WILLIAMSON, var. *carinata* MILLETT, Journ. Roy. Micr. Soc., 1904, p. 498, pl. 10, fig. 3.

Test small, about  $1\frac{1}{2}$  times as long as broad, wedge-shaped in



peripheral view, dorsal side flat, the last-formed chamber on the ventral side having the greatest thickness, periphery acute with a conspicuous keel of clear shell material, slightly lobulated; chambers 7 in the adult whorl, rapidly increasing in size and becoming proportionately narrower at the proximal end, not inflated, the last-formed one projecting inward in a lobe over the umbilicus and having a sharp keel at its median position on the ventral side, making the chamber appear to have a definite peripheral face; sutures distinct, limbate, slightly depressed, evenly and about equally curved on both sides; wall smooth, finely perforate; aperture on the ventral side under the umbilical lobe.

This form was described from Recent material from the Malay Archipelago "at a few stations but in small numbers." The length of the type specimen, according to Millett's figure, is 0.35 mm.; breadth 0.24 mm.; thickness 0.15 mm. We have a single specimen, slightly smaller, from *Albatross* D 5206, off western Samar, in the Philippines.

*CANCERIS PEROBLONGUS* (Cushman) (Pl. 21, figs. 1-5)

*Pulvinulina peroblonga* CUSHMAN, Publ. No. 342, Carnegie Inst. Washington, 1924, p. 41, pl. 13, figs. 3-5.

Test elongate, about twice as long as broad, sides nearly parallel, periphery subacute, slightly keeled, ventral side more strongly convex than the dorsal; chambers about 8 in the adult whorl, rapidly increasing in size and particularly in height as added, the last-formed one projecting slightly at the base; sutures distinct, not depressed, strongly recurved toward the periphery in the adult; wall smooth, very finely perforate, with a small clear area near the base on the ventral side; aperture a low, arched opening on the ventral side at the base of the last-formed chamber. Length 0.55-0.65 mm.; breadth 0.25-0.30 mm.; thickness 0.18-0.22 mm.

The types of this species are from 50 fathoms, south of Breaker Point, between the mouth of Pago Pago Harbor and Taema Bank, Tutuila, Samoa.

This is a distinctive species with its elongate test, narrow chambers, and very large proportion of the ventral surface occupied by the last chamber.

*Canceris peroblongus* also occurs in the Philippines at two

*Albatross* stations: D 5230, 118 fathoms, between Bohol and Leyte Islands; and D 5110, 135 fathoms, China Sea off southern Luzon. The Philippine specimens are not quite as elongate as the Samoan ones but have the same general characters.

**CANCERIS DANVILLENSIS** Howe and Wallace (Pl. 21, figs. 6-8)

*Canceris danvillensis* HOWE and WALLACE, Bull. 2, Louisiana Geol. Survey, 1932, p. 67, pl. 13, figs. 4, 5.

"Test longer than broad, biconvex, the ventral side more strongly convex than the dorsal; periphery acute, outlined by a thin, clear keel; chambers fairly numerous, all can be seen from the dorsal side, about six appear on the ventral side of adult specimens, in younger specimens the last chamber is about one-half the size of the entire test, in more mature specimens the last few chambers become more elongate and extend the periphery so that the outline becomes almost circular; sutures on the dorsal side slightly limbate and strongly curved, on the ventral side strongly depressed, radial and only slightly recurved near the outer end; umbilicus deep and in adult specimens surrounded by prominent bosses caused by the thickening of the inner edges of the chambers; wall smooth, finely perforate; aperture a slit at the inner margin of the last chamber on the ventral side, provided with a thin lip.

"Length 0.55 mm.; breadth 0.4 mm.

"This species differs from both *Canceris auricula* and *Canceris sagra* in having a large, deep, open umbilicus. Specimens are abundant in the upper beds and extremely rare in the lower."

The types of this species are from the upper Eocene, Jackson, of Danville Landing, Ouachita River, Catahoula Parish, La.

From a study of paratype and topotype specimens kindly furnished by Doctor Howe, this species seems to be very distinctive. The last-formed chamber is very thin-walled and often broken. The prominent boss-like projections near the umbilical area are distinctive but vary greatly in different specimens.

**CANCERIS BAGGI** Cushman and Kleinpell (Pl. 21, figs. 9, 10)

*Canceris baggi* CUSHMAN and KLEINPELL, Contr. Cushman Lab. Foram. Res., vol. 10, 1934, p. 15, pl. 3, fig. 2.—KLEINPELL, Miocene Stratigraphy of California, 1938, p. 323.



*Pulvinulina brongniartii* BAGG (not D'ORBIGNY), Bull. 268, U. S. Geol. Survey, 1905, p. 50, pl. 10, fig. 2.

*Cancris brongniartii* KLEINPELL (not D'ORBIGNY), Miocene Stratigraphy of California, 1938, p. 323.

*Pulvinulina auricula* BAGG (not FICHTEL and MOLL), Bull. 268, U. S. Geol. Survey, 1905, p. 50, pl. 10, fig. 3.

"Test strongly biconvex, somewhat longer than broad, periphery keeled, spire on dorsal side somewhat convex, ventrally strongly convex; chambers distinct, inflated, particularly on the ventral side, seven or eight in the last-formed whorl, enlarging rapidly in size and length as added; sutures distinct, depressed, particularly on the ventral side, curved, slightly limbate; wall smooth, finely perforate; aperture ventral, low, toward the umbilicus. Length 1.05 mm.; breadth 0.85 mm.; thickness 0.65 mm."

The types are from the Miocene, Monterey shale, Henry Ranch, Graves Creek, San Luis Obispo Co., Calif.

We have examined Bagg's original material of both "*Pulvinulina brongniartii*" and "*P. auricula*" and find that they are both *Cancris baggi*.

CANCNIS BAGGI Cushman and Kleinpell, var. PLANUS Cushman and Todd, n. var.

(Pl. 21, fig. 11)

Variety differing from the typical in the smaller size and more sharply carinate and less convex form. Length about 0.75 mm.; breadth 0.60-0.65 mm.; thickness 0.25-0.30 mm.

Holotype (Cushman Coll. No. 38779) from the upper middle Miocene, Choctawhatchee formation, *Arca* zone, 100 feet below falls near head of Vaughan's Creek, sec. 27, T. 2 N., R. 19 W., Walton Co., Fla. (U. S. G. S. Loc. 12046.)

The variety also occurs at a number of additional stations in the Miocene of Florida, in the Miocene at Los Sauces Creek, Calif., and more rarely in Recent material from off California.

Cases of species occurring fossil in the Miocene of Florida and living in the Pacific have been noted in other genera, particularly *Bolivina*.

This variety may have been the ancestral form from which *C. baggi* developed in the Miocene of California.

**CANCERIS CUBENSIS** Cushman and Bermudez (Pl. 22, figs. 1-3)

*Canceris cubensis* CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 13, 1937, p. 25, pl. 2, figs. 48-50.—BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 11, 1937, p. 343.—PALMER, l. c., vol. 15, 1941, p. 197, pl. 16, figs. 1, 12.

"Test nearly equally biconvex, periphery acute, with a slight keel; chambers few, five in the final whorl, overlapping, of rather uniform shape but increasing very rapidly in size as added; the last chamber making up nearly half the surface of the test, slightly inflated; sutures slightly depressed, on the dorsal side gently curved, ventrally nearly radial; wall smooth; aperture ventral, a low, elongate opening, near the umbilical end of the last-formed chamber. Length 0.75 mm.; breadth 0.55 mm.; thickness 0.40 mm."

The types are from the Eocene, 4.5 kms. W. of Guanajay, on road to Mariel, Pinar del Rio Province, Cuba. Mrs. Palmer has recorded it from the upper Oligocene, Cojimar formation, of Cuba.

The species resembles *C. claibornensis* Howe but is larger, more compact, and the final chamber relatively lower and broader.

**CANCERIS PAUCILOCLATUS** Cushman and McGlamery (Pl. 22, fig. 4)

*Canceris sagra* (D'ORBIGNY), var. *pauciloculata* CUSHMAN and MCGLAMERY, U. S. Geol. Survey Prof. Paper 189-D, 1938, p. 110, pl. 27, fig. 6; l. c. Prof. Paper 197-B, 1942, p. 74.

*Pulvinulina sagra* CUSHMAN (not D'ORBIGNY), l. c. Prof. Paper 133, 1923, p. 45, pl. 6, figs. 9, 10.—COLE and PONTON, Bull. 5, Florida Geol. Survey, 1930, p. 43, pl. 5, fig. 6; pl. 11, fig. 1.

Test about equally biconvex, dorsal side somewhat flattened, periphery with a narrow keel; chambers few, 4 or 5 making up the adult whorl, rapidly increasing in size as added, the adult chamber with the sides near the base nearly parallel and the outer margin broadly rounded, on the ventral side with a clear area toward the base; sutures distinct, nearly tangential on the dorsal side and slightly sigmoid, on the ventral side nearly radial, slightly curved forward toward the periphery; wall smooth, finely perforate; aperture a low, arched opening in the umbilical area with a projecting lip above the opening. Length of holotype 0.45 mm.; breadth 0.30 mm.; thickness 0.18 mm. Some of the recorded specimens are somewhat larger than the type.



The types are from the Oligocene, Chickasawhay member of the Byram marl, from limestone, 2 to 3 feet above water level, Choctaw Bluff, Alabama River, Ala. It is also recorded from the Chickasawhay marl member near Millry, Ala.; from the Glendon limestone, loose blocks below waterfall in Glass Bayou, Vicksburg, Miss.; and from the Marianna limestone, Jackson Co., Fla. We have found it in the Byram marl from Harts Bridge, Bed 5, Five Runs Creek, Covington Co., Ala.

**CANCERIS CLAIBORNENSIS** Howe (Pl. 22, figs. 5-7)

*Canceris claibornensis* HOWE, Bull. 14, Louisiana Geol. Survey, 1939, p. 78, pl. 10, figs. 20, 21.

"Test very small, compressed, composed of about six chambers, five in the main whorl, dorsal side flattened, ventral side slightly convex, somewhat umbilicate; periphery keeled with a margin of clear shell material; dorsal sutures limbate, very slightly if at all depressed, ventral sutures slightly depressed; aperture near the umbilicus, beneath a lobe of the last chamber which partially covers the umbilical area."

The holotype is from the Claiborne Eocene of Cook Mountain age, light-gray, glauconitic, calcareous clay, taken in run-off ditch 42 feet below top of cut on the NW. side of State Highway 6 in NW. corner of SE.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  NE.  $\frac{1}{4}$  sec. 16, T. 10 N., R. 5 W., Winn Parish, La. It measures: length 0.26 mm.; breadth 0.16 mm.; thickness 0.09 mm.

Our figured specimen is from the Cook Mountain Eocene, 2 $\frac{1}{2}$  miles S. of Quitman, Clarke Co., Miss. It measures: length 0.37 mm.; breadth 0.27 mm.; thickness 0.16 mm.

This species is apparently rare. It is distinctive in the comparatively few chambers in the adult test and the rapid increase in size of the chambers.

**CANCERIS MAURYAE** Cushman and Renz (Pl. 22, fig. 8)

*Canceris mauryae* CUSHMAN and RENZ, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 11, pl. 2, fig. 17.

"Test nearly equally biconvex, periphery subacute and slightly keeled; chambers distinct, about 10 in the final whorl, increasing rather rapidly in size as added, the last two or three making up more than half of the test, slightly inflated; sutures distinct,

slightly limbate and raised, especially on the dorsal side; wall smooth; aperture a low slit below the ventral extension of the last-formed chambers. Length of holotype 0.70 mm.; breadth 0.50 mm.; thickness 0.35 mm."

The types are from the Midway Eocene, Soldado formation, Soldado Rock, Trinidad, B. W. I.

From its peculiar extension of the ventral side, this species may perhaps belong to *Valvulineria*. *C. mauryae* is the earliest known species referred to *Cancris*. The other early species of the Eocene and Oligocene are simpler in their form and development which would suggest that *C. mauryae* may not be a true *Cancris*. Possibly a study of a series of young specimens showing the early stages might determine this.

**CANCNIS TORQUERTUS** Cushman and Todd, n. sp. (Pl. 22, figs. 9, 10)

Test large for the genus, elongate, nearly twice as long as broad, strongly biconvex, the axis of coiling distinctly twisted, periphery acute, slightly keeled, later portion of the adult whorl with the sides nearly parallel; chambers distinct, usually 7 in the adult whorl, on the dorsal side curved but not inflated, ventrally strongly inflated, of rather uniform shape on the dorsal side, on the ventral side the last-formed chamber forming about two-thirds of the surface, with a broad extension over the umbilical region; sutures on the dorsal side nearly radial from the center outward then becoming strongly curved toward the periphery, slightly limbate and not depressed, on the ventral side nearly radial, strongly depressed; wall smooth, finely perforate, with a large, broad clear area over the umbilical region; aperture a low,

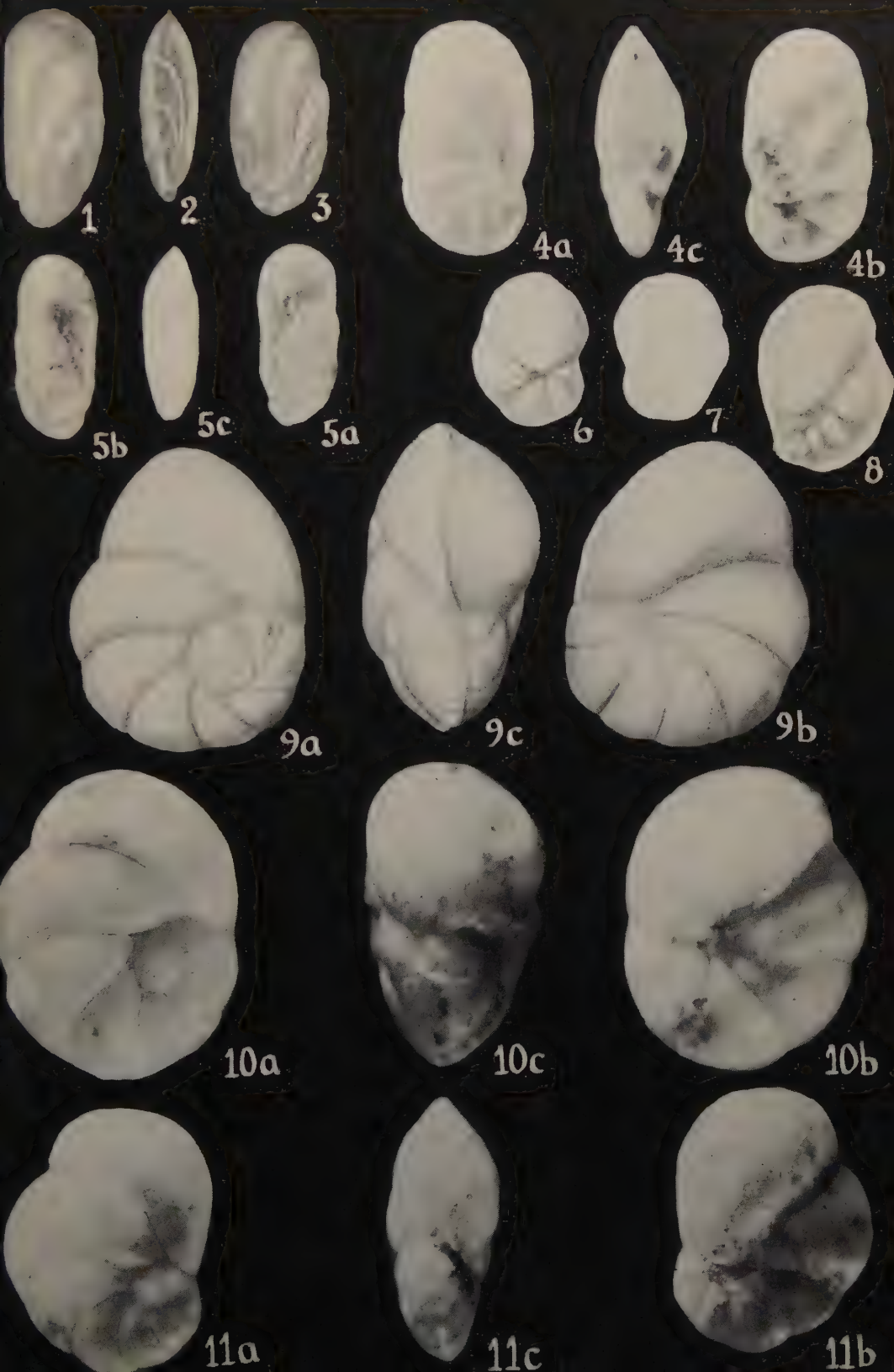
**EXPLANATION OF PLATE 21**

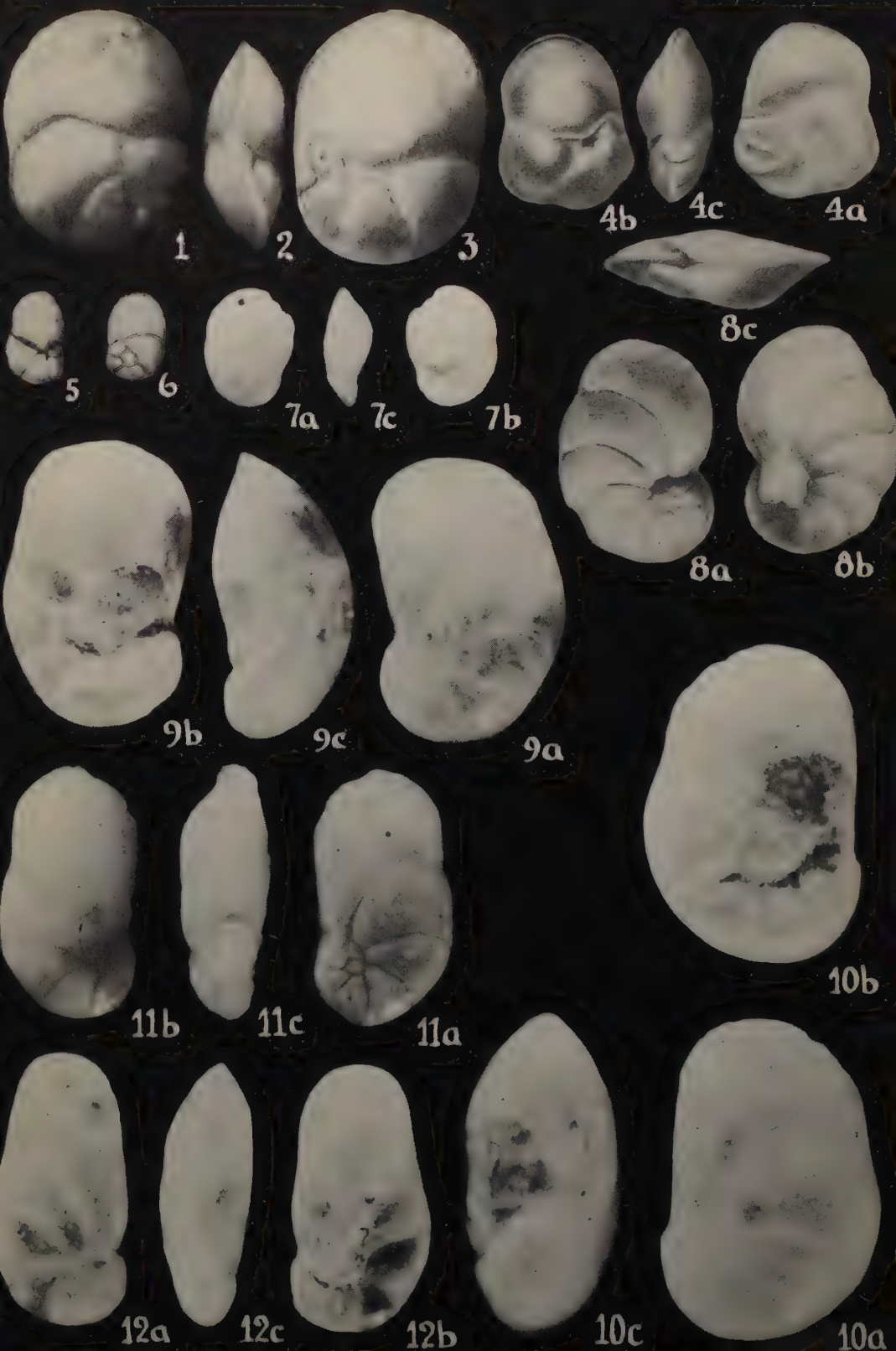
All figures approximately  $\times 50$

*a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIGS. 1-5. *Cancris peroblongus* (Cushman). 1-3, Recent, Samoa. (After Cushman). 4, *Albatross* D 5110, China Sea, off southern Luzon. 135 fathoms. 5, Paratype. Samoa. 6-8. *C. danvillensis* Howe and Wallace. Jackson Eocene, Catahoula Parish, La. (After Howe and Wallace). 9, 10. *C. baggi* Cushman and Kleinpell. Miocene, Monterey shale, Calif. 9, (After Cushman and Kleinpell). 10, From Bagg's material. 11. *C. baggi* Cushman and Kleinpell, var. *planus* Cushman and Todd, n. var. Holotype. Miocene, Choctawhatchee formation, *Arca* zone, 100 feet below falls near head of Vaughan's Creek, sec. 27, T. 2 N., R. 19 W., Walton Co., Fla.









elongate opening on the ventral margin of the last-formed chamber. Length 0.75-1.00 mm.; breadth 0.55-0.70 mm.; thickness 0.40-0.45 mm.

Holotype (Cushman Coll. No. 38782) from *Albatross* D 5116, 200 fathoms, Sombrero Island, N. 69° E., 2½ miles (lat. 13° 41' N., long. 120° 47' 05" E.). Specimens also occur in the *Albatross* Philippine Expedition collections from D 5198, 220 fathoms, Baliscasag Id., S. 6° E., 10¼ miles (lat. 9° 40' 50" N., long. 123° 39' 45" E.); D 5212, 108 fathoms, E. of Masbate Id. (lat. 12° 04' 15" N., long. 124° 04' 36" E.); D 5289, 172 fathoms, China Sea, off southern Luzon (lat. 13° 41' 50" N., long. 120° 58' 30" E.); and D 5590, 310 fathoms, near Sibuko Bay, Borneo (lat. 4° 10' 50" N., long. 118° 39' 35" E.).

*Cancris torquertus* differs from *C. oblongus* (Williamson) in its distinctly twisted axis of coiling which gives an arched appearance to the whole test, and in being proportionately thicker.

**CANCNIS INTERMEDIUS** Cushman and Todd, n. sp. (Pl. 22, figs. 11, 12)

*Cancris auricula* CHAPMAN, PARR, and COLLINS (not FICHTEL and MOLL), Journ. Linn. Soc. Zool., vol. 38, 1934, p. 567, pl. 10, fig. 24.

Test elongate, about twice as long as broad, unevenly biconvex, dorsal side nearly flat, ventral side strongly convex, the early coiled portion wider than the later adult portion, peripheral margin in the later portion nearly straight on the outer side, periphery of the early portion rounded, in the adult chamber subacute; chambers typically 7 in the adult whorl, increasing rapidly in height in the adult, inflated on the ventral side; sutures distinct,

#### EXPLANATION OF PLATE 22

All figures approximately  $\times 50$

*a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIGS. 1-3. *Cancris cubensis* Cushman and Bermudez. Eocene, Cuba. (After Cushman and Bermudez). 4. *C. pauciloculatus* Cushman and McGlamery. Oligocene, Alabama. (After Cushman and McGlamery). 5-7. *C. claibornensis* Howe. 5, 6, Claiborne Eocene, Winn Parish, La. (After Howe). 7, Claiborne Eocene, Clarke Co., Miss. 8. *C. maurayae* Cushman and Renz. Eocene, Trinidad, B. W. I. (After Cushman and Renz). 9, 10. *C. torquertus* Cushman and Todd, n. sp. 9, *Albatross* D5116. Lat. 13° 41' N., long. 120° 47' 05" E. 200 fathoms. 10, Holotype. *Albatross* D 5590, Sibuko Bay, Borneo. 310 fathoms. 11, 12. *C. intermedius* Cushman and Todd, n. sp. 11, Holotype. Miocene, Western Beach, Geelong, Victoria, Australia. 12, Oligocene, Balcombian, Clifton Bank, Muddy Creek, Victoria, Australia.

slightly limbate on both sides, slightly depressed and only slightly curved on the ventral side, strongly curved on the dorsal side, especially toward the periphery; wall smooth, finely perforate, with a broad, almost triangular clear area at the base of the last-formed chamber on the ventral side; aperture a small arched opening close to the periphery on the ventral side at the base of the last-formed chamber. Length 0.70-0.80 mm.; breadth 0.38-0.40 mm.; thickness 0.25-0.30 mm.

Holotype (Cushman Coll. No. 38783) from the Miocene of Western Beach, Geelong, Victoria, Australia. It also occurs in material from the Miocene of quarries near Batesford, and Mortlake, Victoria, Australia, and from the Oligocene (Balcombian) at Clifton Bank, Muddy Creek, and in Altona Bay Coal Shaft, Victoria, Australia.

This species differs from *C. torquertus* Cushman and Todd, n. sp. in the smaller size, more elongate form, and less twisted final chambers. It may possibly be the ancestral form of *C. torquertus*.

The figured specimen from the upper Eocene of New Zealand, referred by Chapman to *Pulvinulina auricula* Fichtel and Moll (New Zealand Geol. Survey, Pal. Bull. No. 11, 1926, p. 81, pl. 16, fig. 8), has some resemblance to this species but is more elongate and has a larger number of chambers.

**CANCERIS OVATUS** Cushman and Todd, n. sp. (Pl. 23, figs. 1, 2)

Test  $1\frac{1}{2}$  times as long as broad, about equally biconvex, periphery entire with no indentation where the last-formed chamber meets the previous whorl, little if at all lobulated, with a narrow but distinct keel of clear shell material; chambers arcuate, becoming longer and proportionately narrower at the proximal end as added, 7 in the adult whorl, slightly inflated on the ventral side with a broad lobe at the inner end of the last-formed chamber projecting inward over the umbilicus, overlapping so that the last-formed chamber comprises more than half the ventral surface of the test; sutures distinct, on the dorsal side straight at their proximal ends, becoming strongly curved near the periphery, distinctly limbate but not raised, depressed on the ventral side; wall smooth, finely perforate, except for an oval clear area about  $\frac{1}{3}$  the height of the chamber on the ventral



side at the base of the last-formed chamber; aperture an elongate opening under a slight lip on the peripheral part of the lobe covering the umbilicus. Length 0.55-0.65 mm.; breadth 0.40-0.45 mm.; thickness 0.20 mm.

Holotype (Cushman Coll. No. 38785) from the Oligocene (Balcambian) of Clifton Bank, Muddy Creek, Victoria, Australia. It also occurs in the Miocene (Janjukian) of Mortlake, Victoria, Australia.

This species differs from *C. intermedius* Cushman and Todd, n. sp. with which it occurs in being less elongate and more smoothly ovate in outline and in its flatter form with more acute periphery.

*CANCERIS* sp. (Pl. 23, figs. 3, 4)

*Canceris brongniartii* CUSHMAN (not D'ORBIGNY), U. S. Geol. Survey Prof. Paper 181, 1935, p. 48, pl. 20, fig. 1.

In the American upper Eocene material we have a rare species which may be referred to *Canceris*, but not enough specimens are available from any one station to warrant a specific identification. Some of the broader forms (Pl. 23, fig. 3) resemble *Canceris cubensis* Cushman and Bermudez from the Eocene of Cuba but others (Pl. 23, fig. 4) are more elongate. Most of these have six chambers in the adult whorl and have a keeled periphery.

Specimens occur in the Jackson Eocene at the following localities: Castle Hayne marl, Wilmington, N. C.; Jackson formation, 1½ miles S. of Shubuta, Miss., and at Hays Chapel, Wayne Co., Miss.; Cooper marl, steep bluff on W. side of Biggin Creek, Berkeley Co., S. C.

Additional material may show that there are two distinct forms included here but they are not identical with *Canceris danvillensis* Howe and Wallace from the Jackson Eocene of Louisiana.

*CANCERIS* sp. (Pl. 23, fig. 5)

*Canceris sagra* CUSHMAN and LAIMING (not D'ORBIGNY), Journ. Pal., vol. 5, 1931, p. 115, pl. 14, fig. 3.

Specimens from the Miocene of Los Sauces Creek, Ventura Co., Calif., one of which is figured, are difficult to place under any of the species names given in this paper. They are characterized by

a rapidly enlarging whorl. Specimens, however, are too few to give the full characters and the available ones are, from their state of preservation, not as complete in details as might be wished.

*CANCERIS INDICUS* (Cushman) (Pl. 23, fig. 7; Pl. 24, figs. 1, 2)

*Pulvinulina indica* CUSHMAN, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 332.

*Pulvinulina hauerii* H. B. BRADY (part) (not D'ORBIGNY, 1846), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 690, pl. 106, fig. 6 (not fig. 7).—MILLETT, Journ. Roy. Micr. Soc., 1904, p. 498.

*Canceris* sp. CUSHMAN, Reports of Great Barrier Reef Committee, vol. 5, 1942, p. 116 (list).

Test somewhat longer than broad, broadly rounded in peripheral view, strongly biconvex, periphery slightly lobulated; chambers inflated, 6 or 7 in the adult whorl, gradually increasing in size as added; sutures on both sides distinctly depressed, slightly curved; wall smooth, conspicuously perforate, with a large oval clear area near the base of the last-formed chamber on the ventral side; aperture a narrow, arcuate opening at the ventral umbilical region of the last-formed chamber. Length 0.70-0.90 mm.; breadth 0.45-0.60 mm.; thickness 0.35-0.50 mm.

The types are from *Albatross* D 5219 in 530 fathoms, between Marinduque and Luzon, Philippine Islands (lat. 13° 21' N., long. 122° 18' 45" E.). It is recorded from several other *Albatross* stations in the Philippine area: D 5134, 34 fathoms, lat. 6° 44' 12" N., long. 121° 46' 55" E.; D 5143, 19 fathoms, lat. 6° 05' 50"

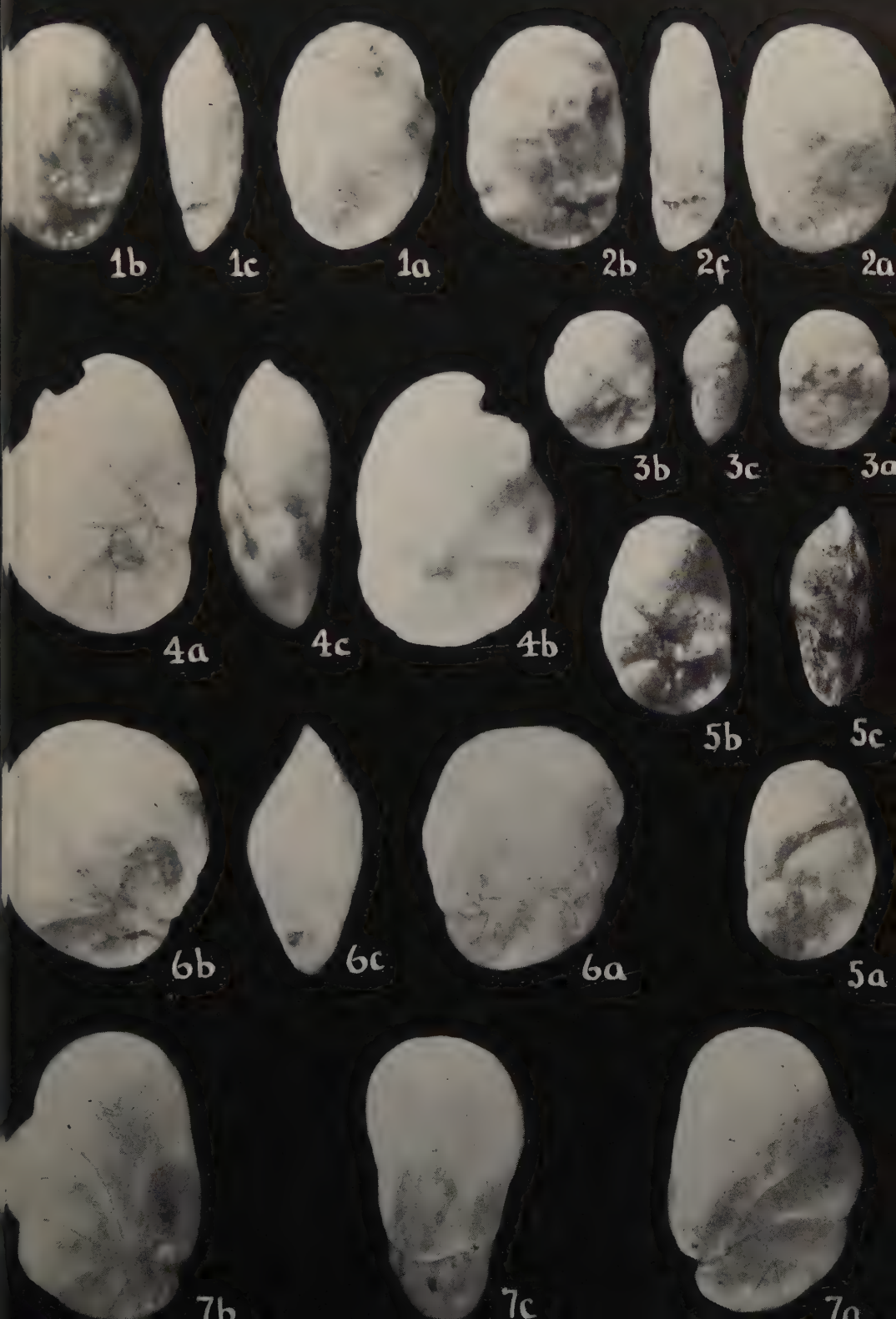
#### EXPLANATION OF PLATE 23

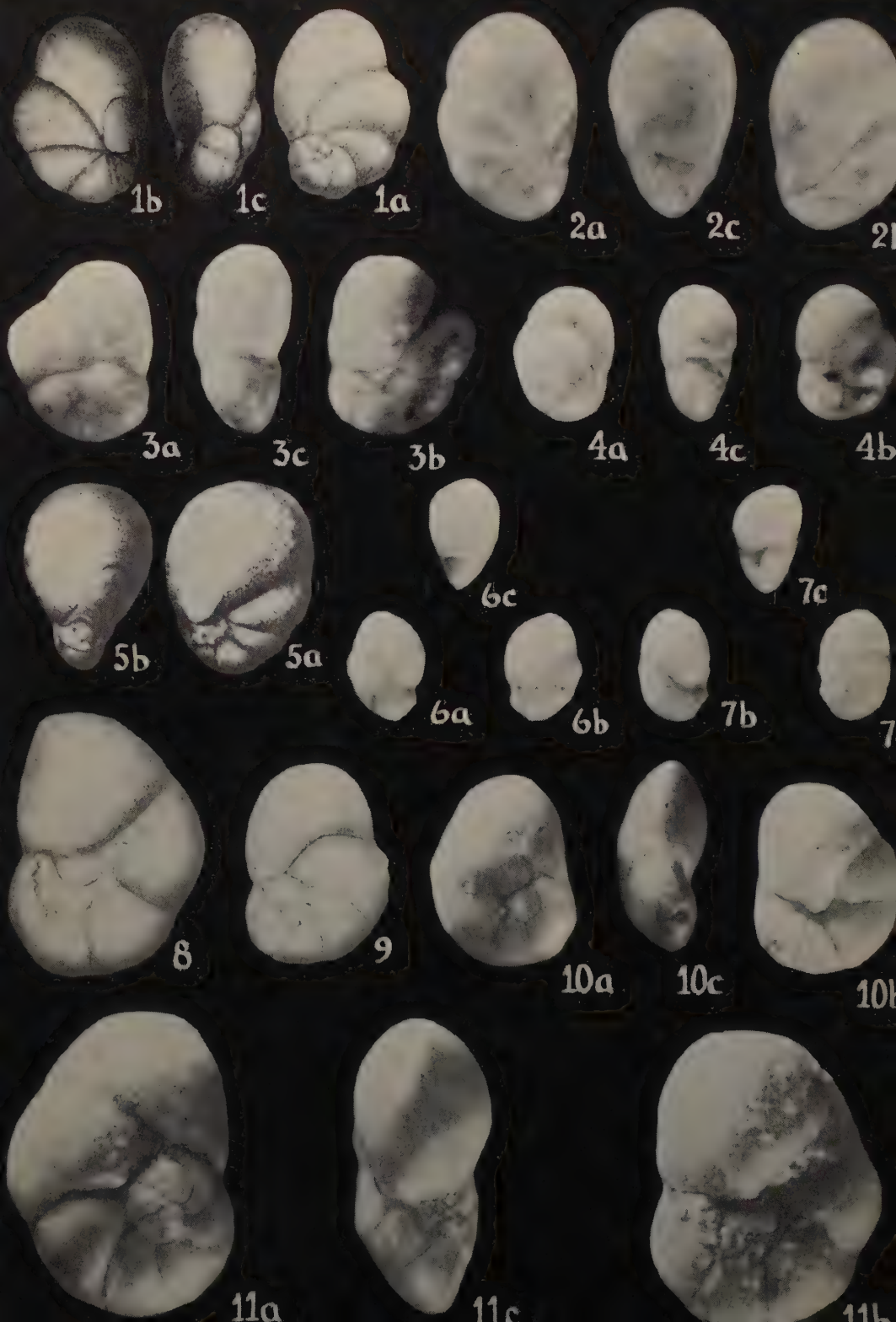
All figures approximately  $\times 50$

*a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIGS. 1, 2. *Canceris ovatus* Cushman and Todd, n. sp. Oligocene, Balcombian, Clifton Bank, Muddy Creek, Victoria, Australia. 1, Holotype. 2, Paratype. 3, 4. *C.* sp. Jackson Eocene. 3, Jackson formation, bluff on Chickasawhay River, at Hays Chapel, Wayne Co., Miss. 4, Cooper marl, bluff W. side of Biggin Creek,  $\frac{3}{4}$  mi. below Coastal Highway, Berkeley Co., S. C. 5. *C.* sp. Miocene, Los Sauces Creek, Ventura Co., Calif. 6. *C. auriculus* (Fichtel and Moll). Recent, *Albatross* D 5178, vicinity of Romblon, Philippines. Lat. 12° 43' N., long. 122° 06' 15" E. 78 fathoms. 7. *C. indicus* (Cushman). Recent, Persian Gulf. 284 meters.







N., long. 121° 02' 15" E.; D 5145, 23 fathoms, lat. 6° 04' 30" N., long. 120° 59' 30" E.; D 5178, 73 fathoms, lat. 12° 43' N., long. 122° 06' 15" E.; and D 5217, 20 fathoms, lat. 13° 20' N., long. 123° 14' 15" E. Excellent specimens are in our material from the Persian Gulf and from off Watson's Bay, Port Jackson, New South Wales. Brady's *Challenger* specimens were from off New Guinea.

This is a distinctive species of the Indo-Pacific.

**CANCERIS TURGIDUS** Cushman and Todd, n. sp. (Pl. 24, figs. 3, 4)

*Pulvinulina haueri* FRANKE (not d'ORBIGNY), Abhandl. Ber. Mus. Naturw.-und-Heimatkunde und Nat. Ver., Bd. 4, Heft 2, 1925, p. 183, pl. 6, fig. 58.

Test slightly longer than broad, strongly biconvex, periphery somewhat lobulate, broadly rounded in peripheral view; chambers about 6 in the adult whorl, inflated, especially on the ventral side, increasing rapidly in size as added; sutures distinct, slightly limbate and distinctly curved on the dorsal side; on the ventral side depressed and nearly radial; wall smooth, finely perforate except for an oval clear area on the ventral side of the last-formed chamber extending about half the height of the chamber; aperture a low, arched opening beneath a distinct lip over the umbilicus on the ventral side. Length 0.45-0.55 mm.; breadth 0.32-0.40 mm.; thickness 0.22-0.28 mm.

Holotype (Cushman Coll. No. 38793) from the Oligocene of Ahnatal, Cassel, Germany, where it is common. It also occurs

#### EXPLANATION OF PLATE 24

All figures approximately  $\times 50$

Unless otherwise noted: *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIG. 1. "*Pulvinulina haueri*" H. B. Brady (not d'Orbigny). Recent, *Challenger* Sta. 217A, Humboldt Bay, Papua. 37 fathoms. (After H. B. Brady). 2. *Canceris indicus* (Cushman). *Albatross* D 5178, vicinity of Romblon, Philippines. Lat. 12° 43' N., long. 122° 06' 15" E. 78 fathoms. 3, 4. *C. turgidus* Cushman and Todd, n. sp. 3, Oligocene, Calbe, near Magdeburg, Germany. 4, Holotype. Oligocene, Ahnatal, Cassel, Germany. 5. "*Pulvinulina indica*" Macfadyen (not Cushman). Miocene, Shallûfa, Egypt. *a*, ventral view; *b*, peripheral view. (After Macfadyen). 6, 7. *Canceris tumidus* Cushman and Todd, n. sp. Miocene, Shallûfa, Egypt. 6, Paratype. 7, Holotype. 8, 9. "*C. sagra*" Nuttall (not d'Orbigny). Oligocene, Alazan shale, Mexico. (After Nuttall). 10, 11. *C. mexicanus* Cushman and Todd, n. sp. Oligocene, Alazan shale, Mexico. 10, Paratype. 11, Holotype. (Figures 8 and 11 are of the same specimen).



in the lower Oligocene of Calbe, near Magdeburg, and at Lattendorf, Germany.

Dr. Franke's material referred to above was from the latter locality. It is quite distinct from d'Orbigny's species as a study of topotypes has shown.

*Canceris turgidus* differs from *C. indicus* (Cushman) in the shorter, broader test, smaller size, and more evenly elliptical shape in peripheral view. It is probably the ancestral form of *C. indicus*.

**CANCERIS TUMIDUS** Cushman and Todd, n. sp. (Pl. 24, figs. 5-7)

*Pulvinulina indica* MACFADYEN (not CUSHMAN), Geol. Survey Egypt, 1930 (1931), p. 101, pl. 4, fig. 13.

Test only slightly longer than broad, the periphery in the early stages acute, becoming very broadly rounded in the adult; chambers 6 or 7 in the adult whorl, strongly inflated and increasing rapidly in size in the adult whorl, the final one subspherical and larger than the rest of the test; sutures nearly radial, depressed; wall smooth, finely perforate, very thin in the last-formed chamber with a large, oval, clear area on the ventral side; aperture a low opening on the ventral side at the base of the last-formed chamber. Length 0.45-0.60 mm.; breadth 0.40-0.50 mm.; thickness 0.35-0.40 mm.

Holotype (Cushman Coll. No. 38794) from the Miocene of Shallûfa, Egypt (lat. 30° 08' 10" N., long. 32° 32' 30" E.).

This species differs from *C. indica* (Cushman) in the smaller size, more inflated and nearly spherical last-formed chamber which makes up a much larger proportion of the whole test.

Through the kindness of Dr. Macfadyen we have material showing these characters from his Egyptian locality. The species may possibly be derived from *C. turgidus* Cushman and Todd, n. sp. from the Oligocene of Central Europe.

**CANCERIS MEXICANUS** Cushman and Todd, n. sp. (Pl. 24, figs. 8-11)

*Canceris sagra* NUTTALL (not D'ORBIGNY), Journ. Pal., vol. 6, 1932, p. 27, pl. 6, figs. 6, 7.

Test slightly longer than broad, strongly biconvex, periphery rounded; chambers few, 5 or 6 in the adult whorl, of uniform shape on the dorsal side increasing rather regularly in size as added, the last-formed one roughly triangular except for the

basal lobe on the ventral side, oval in peripheral view, inflated, especially on the ventral side; sutures distinct, slightly depressed on the dorsal side, strongly so on the ventral side, distinctly curved on the dorsal side, radiate on the ventral side; wall smooth, distinctly perforate; aperture a low opening beneath the umbilical extension of the ventral side of the last-formed chamber. Length 0.60-0.95 mm.; breadth 0.50-0.70 mm.; thickness 0.30-0.40 mm.

Holotype (Cushman Coll. No. 38797) from the Oligocene, Alazan shale, of western Asuncion, State of Vera Cruz, Mexico. The type specimens are the ones referred to by Dr. Nuttall in the above reference.

This species differs from *C. sagra* (d'Orbigny) in the larger size, in the more broadly biconvex and more rounded test, in the more triangular form of the final chamber, and in the rounded periphery lacking a keel.

The species named *Cancris panamensis* by Natland (Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 4, No. 5, 1938, p. 148, pl. 6, fig. 1) is probably not a true *Cancris*.

## RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the foraminifera that have come to hand:

- Howell, B. F. and Paul H. Dunn. Early Cambrian "Foraminifera."—Journ. Pal., vol. 16, No. 5, Sept., 1942, pp. 638, 639, pl. 91.—Description and figures of a possible foraminifer, *Psammosphaera* ? *greenlandensis*, n. sp. from the lower Cambrian of Ella Island, East Greenland.
- Cole, W. Storrs. *Lockhartia* in Cuba.—L. c., pp. 640-642, pl. 92.—Description and figures of two species: *Miscellanea catenula* (Cushman and Jarvis) and *Lockhartia bermudezi*, n. sp. This is the first record of *Lockhartia* in the Western Hemisphere.
- Fox, S. K., Jr. and R. J. Ross, Jr. Foraminiferal Evidence for the Midway (Paleocene) Age of the Cannonball Formation in North Dakota.—L. c., pp. 660-673, 5 text figs.—Lists and distribution of numerous species of foraminifera are given.

- Cushman, J. A. and S. S. Siegfus. Foraminifera from the Type Area of the Kreyenhagen Shale of California.—Trans. San Diego Soc. Nat. Hist., vol. IX, No. 34, Oct. 1, 1942, pp. 385-426, pls. 14-19, diagram, table.—Numerous species described and figured, one new: *Ellipsopleurostomella stewarti*, n. sp.
- Brodermann, Jorge. Investigacion Geologica de las Aguas Minero-medicinales de la Provincia de la Habana.—Conferencia Pronunciada en la Academia de Ciencias el dia 13 de Junio del Ano 1941 (Havana 1942), pp. 1-27.—Lists numerous foraminifera, and reviews development of work on the group.
- Tromp, S. W. The micro-faunae of the basal-eocene and upper cretaceous section of Ramandag Well No. 2 (S. E. Turkey).—Bull. Mining Research Institute of Turkey, 1942, pp. 113-125, table.—Notes are given, and a table of distribution of numerous genera. Pages 121-125 in English; earlier portion in Turkish.
- Frenzel, Hugh and Maurice Mundorff. Fusulinidae from the Phosphoria formation of Montana.—Journ. Pal., vol. 16, No. 6, Nov., 1942, pp. 675-684, pls. 99, 100, text figs. 1-5.—Two species described and figured: *Pseudoschwagerina montanensis*, n. sp., and *Schwagerina laxissima* Dunbar and Skinner.
- Thompson, M. L. and Harry E. Wheeler. Permian fusulinids from British Columbia, Washington, and Oregon.—L. c., pp. 700-711, pls. 105-109, 2 text figs.—Several species described, the following new: *Schwagerina pavilionensis*, n. sp., var. *acris*, n. var.; *Yabeina minuta*, n. sp.; and *Y. packardi*, n. sp., the first records for the latter genus in the Permian of America.
- Burma, Benjamin H. Missourian *Triticites* of the northern mid-Continent.—L. c., pp. 739-755, pl. 118, 14 text figs.—Several species described and figured, the following new: *Triticites burgessae*, n. sp.; *T. collus*, n. sp.; *T. caccus*, n. sp.; and *T. newelli*, n. sp.

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